Designing Embedded Systems using the ESP32

DAY 1 : Introduction to the ESP32 Wi-Fi Module

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THE SPEAKER

Jacob Beningo

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Beningo Embedded Group - President

Focus: Embedded Software Consulting

An independent consultant who specializes in the design of real-time, microcontroller based embedded software.
He has published two books:
- Reusable Firmware Development
- MicroPython Projects

Writes a weekly blog for DesignNews.com focused on embedded system design techniques and challenges.
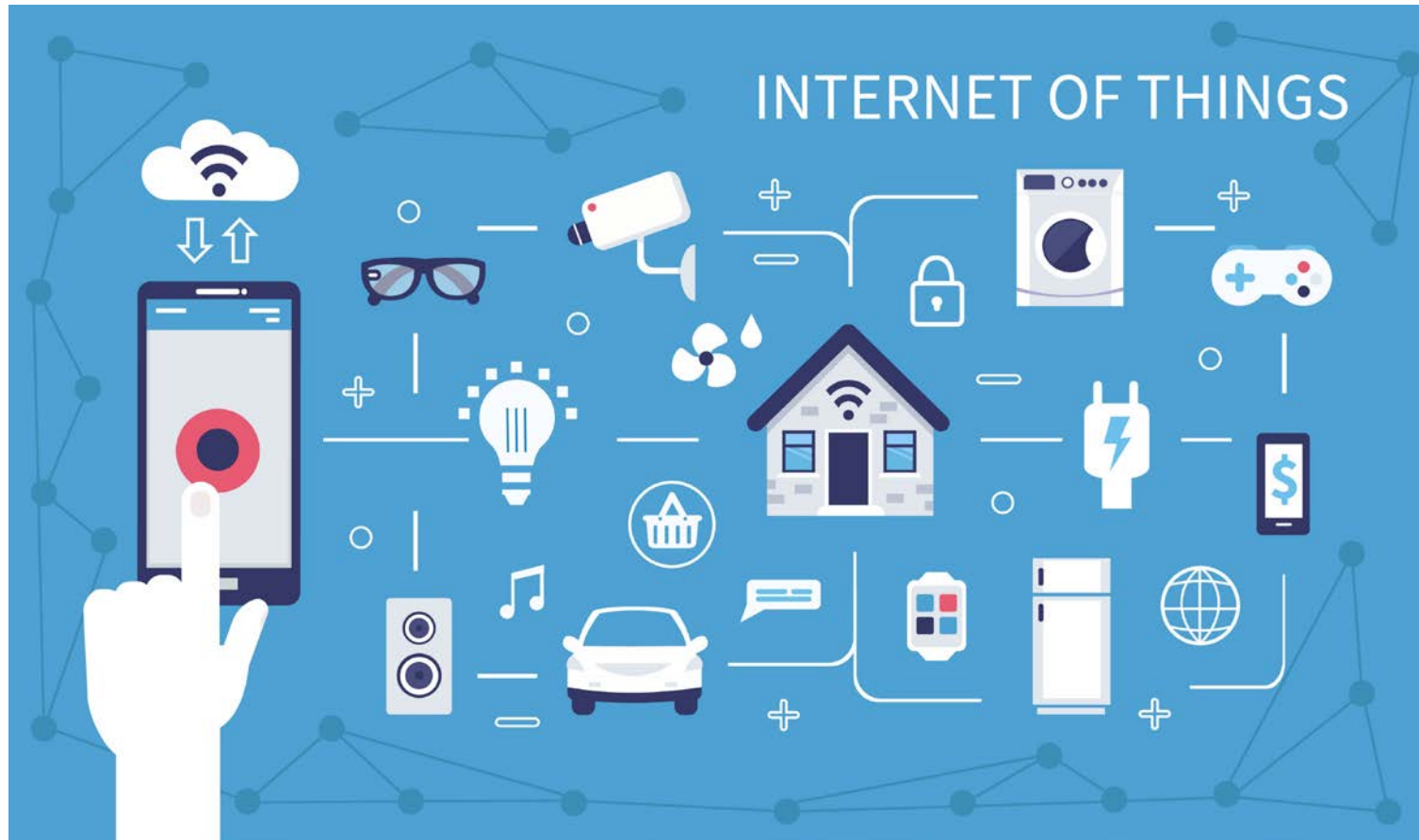
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Course Sessions

- **Introduction to the ESP32 Wi-Fi Module**
- Setting up and Exploring the SDK
- Programming and Writing the First Application
- It's all about Wi-Fi
- Jump-Starting Cloud Connectivity Applications with Amazon FreeRTOS

Introduction

ESP32 – is a series of low-cost, low-power SoC microcontrollers with integrated Wi-Fi and dual-mode Bluetooth

- Low cost SoC Microcontroller
- Tensilica Xtensa LX6 microprocessor
  - Single and Dual core variants
  - 160 MHz or 240 MHz
- Low-power management
- Large peripheral set
- Internal or external antenna
- Open-source software frameworks

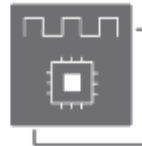# Enough solutions and tools to confuse even the best developers!
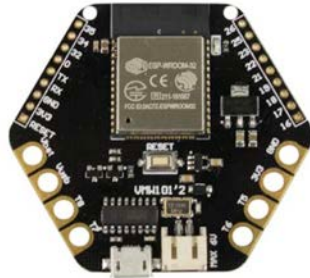
ESP32 Modules

ESP32-SOLO Series

The ESP32-SOLO-1 module is based on ESP32-S0WD and has integrated flash memory, thus providing a cost-effective solution for simple Wi-Fi and Bluetooth/Bluetooth LE-based connectivity applications.

ESP32-WROOM Series

These are ESP32-D0WD-based modules with integrated flash. These modules are well suited for Wi-Fi and Bluetooth/Bluetooth LE-based connectivity applications and provide a solid dual-core performance.

ESP32-WROVER Series

The ESP32-WROVER series is based on ESP32-D0WD SoC, having also integrated flash memory and SPIRAM. They have a fine dual-core performance, and are well suited for applications requiring more memory, such as AIoT and gateway applications.

Image Sources: Espressif

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ESP32 Modules

Feature List	CPU & Memory			
	Core	Core clock maximum freq.	Flash (MB)	PSRAM (MB)
ESP32-WROOM-32E ESP32-WROOM-32UE	ESP32-D0WD-V3 Dual Core	240 MHz	4,8,16	N/A
ESP32-WROVER-E ESP32-WROVER-IE	ESP32-D0WD-V3 Dual Core	240 MHz	4,8,16	8
ESP32-MINI-1	ESP32-U4WDH Single Core	160 MHz	4MB Flash packaged in chipset	N/A
ESP32-SOLO-1	ESP32-S0WD Single Core	160 MHz	4	N/A
ESP32-WROOM-32SE	ESP32-D0WD Dual Core	240 MHz	4,8,16	N/A

Image Sources: Espressif

ESP32 Common Features

- SD card, UART, SPI, SDIO, I2C, LED PWM, Motor PWM, I2S, IR, pulse counter, GPIO, capacitive touch sensor, ADC, DAC
- Touch Sensor
- 802.11 b/g/n (802.11n up to 150 Mbps), 2.4 GHz*
- Bluetooth V4.2 BR/EDR, Bluetooth LE specification
- 38 pin footprint

* Some modules support 2.4 GHz – 2.5 GHz

ESP32 Module Footprints

ESP32-WROOM-32E
18x25.5x3.1

ESP32-WROVER-E
18x31.4x3.3

ESP32-WROVER-IE
18x31.4x3.3

ESP32-SOLO-1
18x25.5x3.1

ESP32-MINI-1
13.2×19×2.4

ESP32-WROOM-32UE
18x19.2x3.2

ESP32-WROOM-32SE
18x25.5x3.1

ESP32 Module Costs

Module	Digikey Pricing (Dec 2020)
ESP32-WROOM-32E (4 MB / 8 MB / 16 MB)	$2.50 / $2.80 / $2.99
ESP32-WROOM-32UE (4 MB / 8 MB / 16 MB)	$2.50 / $2.80 / $2.99
ESP32-WROVER-E (4 MB / 8 MB / 16 MB)	$2.80 / $2.99 / $3.28
ESP32-WROVER-IE (4 MB / 8 MB / 16 MB)	$2.80 / $2.99 / $3.28
ESP32-MINI-1 (4 MB)	$2.00
ESP32-SOLO-1 (4 MB)	$3.40
ESP32-WROOM-32SE	Not Currently Available

Which module seems the most interesting to you?
- ESP32-WROOM-32E
- ESP32-WROVER-E
- ESP32-SOLO-1
- ESP32-MINI-1

Development Boards
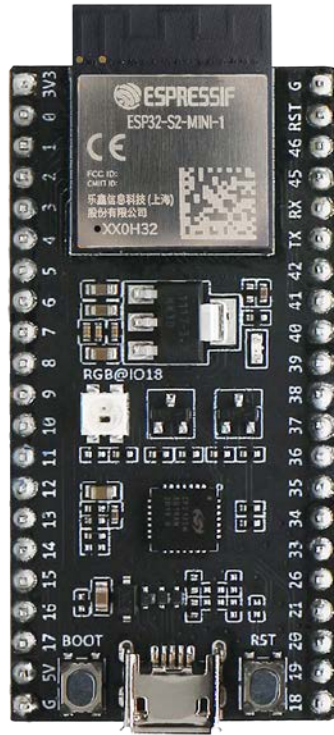
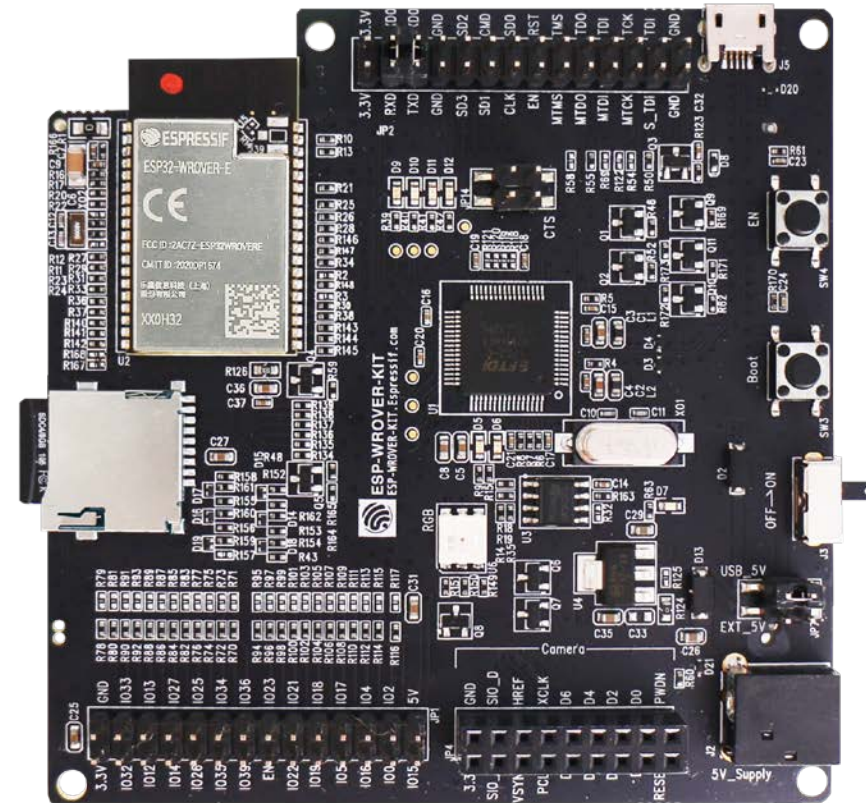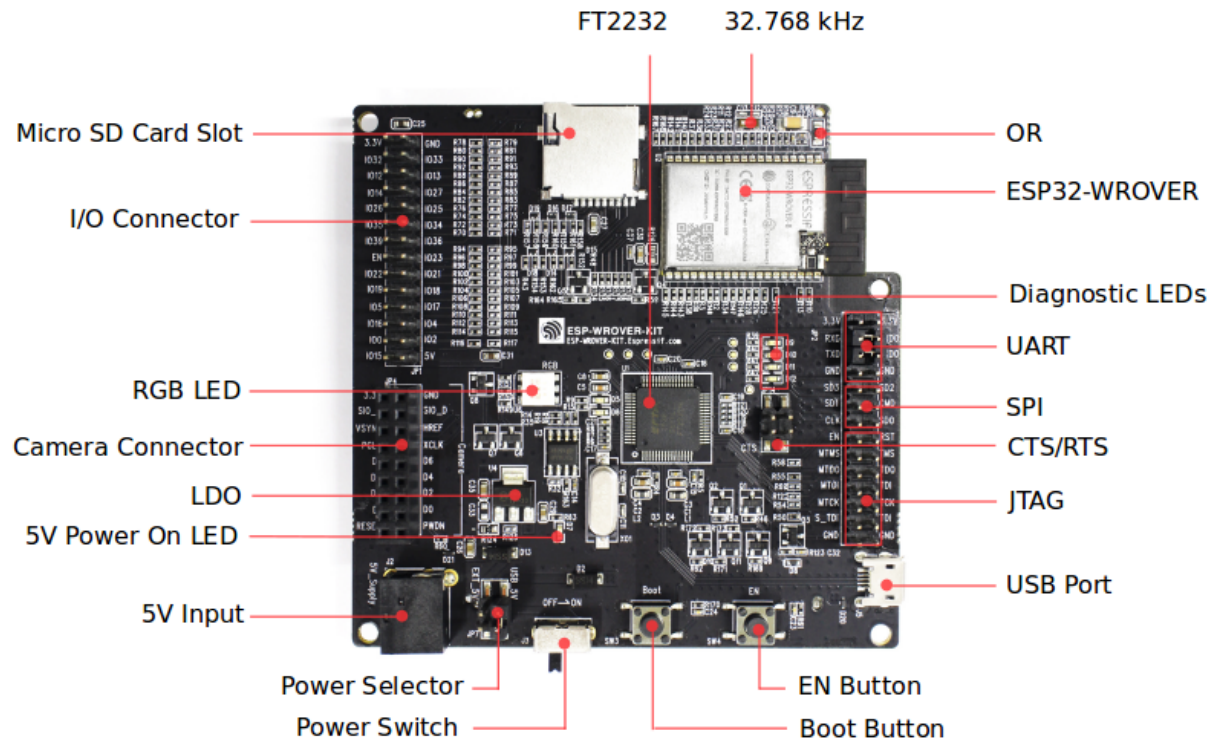ESP32-S2-DevKitM-1   ESP32-DevKitC

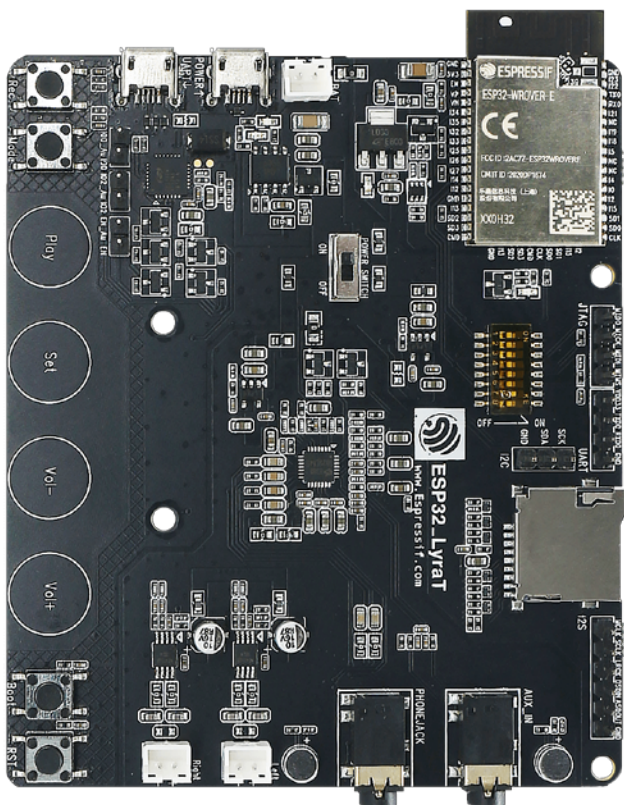# Development Boards

ESP-WROVER-KIT-VE

- AWS Qualified board
- JTAG Debugging onboard
- USB to Serial Interface
- RGB LED
- SD Card
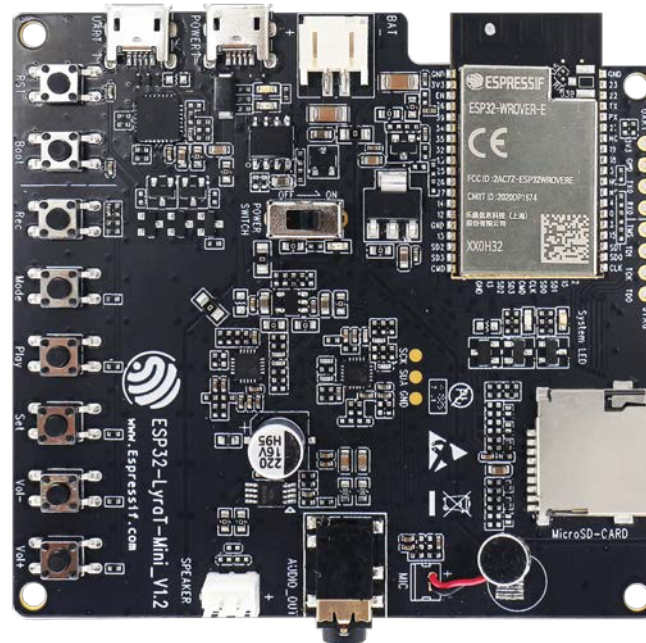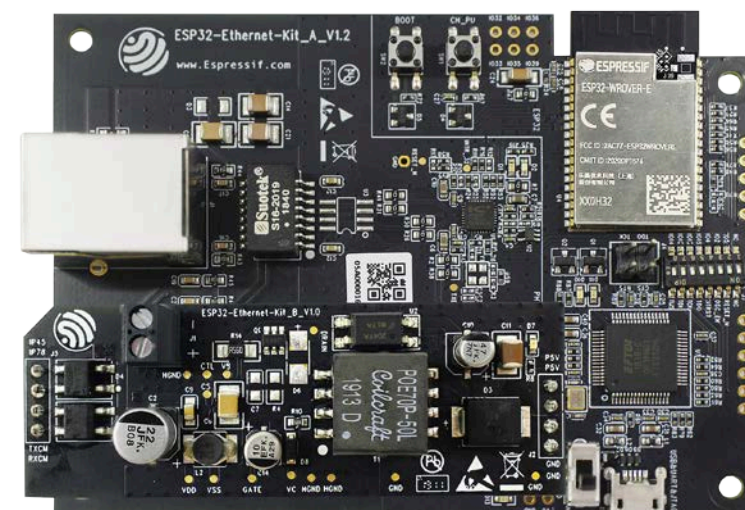- Camera connection
- Expansion I/O
- LCD

Development Boards

FT2232   32.768 kHz

Micro SD Card Slot

I/O Connector

RGB LED

Camera Connector

LDO

5V Power On LED

5V Input

Power Selector

Power Switch

OR

ESP32-WROVER

Diagnostic LEDs

UART

SPI

CTS/RTS

JTAG

USB Port

EN Button

Boot Button

LCD

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Development Boards

ESP32-LyraT

ESP32-LyraT-Mini

ESP32-Ethernet-Kit

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What capabilities are you most interested in for a development board?
- Audio capabilities
- Machine learning
- Ethernet
- Digital signal processing
- Other

Toolchains

- ESP-IDF (IoT Development Framework)
- Amazon FreeRTOS
- Arduino
- MicroPython

Which toolchain are you interesting in using the ESP32 with?
- ESP-IDF
- Amazon FreeRTOS
- Arduino
- MicroPython

Thank you for attending

Please consider the resources below:
- www.beningo.com
  - Blog, White Papers, Courses
  - Embedded Bytes Newsletter
    - http://bit.ly/1BAHYXm

From www.beningo.com under
   - Blog > CEC – Designing Embedded Systems using the ESP32

Thank You

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